What is claimed is:

1. A method for monitoring an industrial process, said method comprising the steps of:

obtaining sensor data corresponding to a plurality of product units being processed in accordance with the industrial process;

forming a sample matrix of data representing at least two of the product units, wherein the sample matrix is formed from at least a portion of the sensor data;

computing a plurality of singular vectors of the sample matrix;

reducing the plurality of singular vectors to a principal set of singular vectors;

computing principal components of sensor data corresponding to at least one additional product unit processed subsequent to the product units represented in the sample matrix;

computing a predicted data vector for the additional product unit;

calculating a residual data vector for the additional product unit using the predicted data vector for the additional product unit and a measured data vector corresponding to the additional product unit, the measured data vector comprising sensor data obtained for the additional product unit;

calculating a scalar metric from the residual data vector for the additional product unit; and

categorizing the additional product unit based on the value of the scalar metric.

2. The method of claim 1 wherein the industrial process comprises a plasma process and wherein the product units comprise semiconductor wafers.

3. The method of claim 2 wherein the sensor data comprises OES data.

4. The method of claim 1 wherein the sensor data comprises at least one of mass spectrometer data, electrical sensor data, and RF sensor data.

5. The method of claim 1 wherein said step of obtaining comprises:

selecting, for each product unit, a single sensor data vector corresponding to a time of interest.

6. The method of claim 5 wherein the time of interest corresponds to an endpoint of the industrial process performed on the product units.

7. The method of claim 1 wherein said step of obtaining comprises:

averaging, for each product unit, a plurality of sensor data vectors to obtain one average sensor data vector corresponding to each product unit.

8. The method of claim 7 wherein in said step of averaging, only data vectors obtained after a predetermined time from a start point of the industrial process preformed on the product unit up to a predetermined time before an endpoint of the industrial process performed on the product unit are averaged.

9. The method of claim 1 further comprising the steps of:

updating the sample matrix by deleting from the sample matrix sensor data corresponding to at least one product unit obtained earlier in time and adding to the sample matrix sensor data corresponding to at least one product unit processed later in time; and

periodically recomputing the singular vectors of the sample matrix; and

periodically reducing the singular vectors to a set of principal singular vectors.

10. The method of claim 1 wherein said step of categorizing comprises:

assigning the additional product unit to a first category if the scalar metric is within a first range;

assigning the additional product unit to a second category if the scalar metric is within a second range; and

assigning the additional product unit to a third category if the scalar metric is within a third range.

11. The method of claim 1 wherein said step of calculating a scalar metric comprises:

calculating the standard deviation of the residual data vector.

12. The method of claim 11 further comprising:

normalizing the standard deviation by an average standard deviation to obtain a normalized standard deviation corresponding to the additional product unit.

13. The method of claim 12 wherein said step of categorizing comprises:

assigning the additional product unit to a first category if the normalized standard deviation corresponding to the additional product unit is less than a first predetermined parameter;

assigning the additional product unit to a second category if the normalized standard deviation corresponding to the additional product unit greater than or equal to the first predetermined parameter and is less than a second predetermined parameter; and

assigning the additional product unit to a third category if the normalized standard deviation corresponding to the additional product unit is greater than or equal to than the second predetermined parameter.

14. The method of claim 13 wherein the value of the first predetermined parameter is 2.0 and the value of the second predetermined parameter is 3.0.

15. The method of claim 1 wherein said step of computing a plurality of singular vectors of the sample matrix comprises:

performing a singular value decomposition on the sample matrix to obtain the plurality of singular vectors.

16. The method of claim 1 wherein said step of calculating a residual data vector for the additional product unit comprises:

subtracting the predicted data vector for the additional product unit from the actual data vector corresponding to the additional product unit.

17. The method of claim 1 wherein said step of calculating a scalar metric from the residual data vector for the additional product unit is performed in real time as product units are undergoing the industrial process.

18. The method of claim 1 further comprising:

outputting on an output device at least one of the scalar metric and the category assigned to the additional product unit.

19. A method for monitoring a plurality of plasma processes, said method comprising the steps of:

obtaining sensor data for a plurality of wafers being processed in accordance with a plurality of plasma processes, wherein the sensor data is obtained at a plurality of times during the processing of each wafer;

forming at least one of a plurality sample matrices from at least a portion of the sensor data, wherein each sample matrix formed is associated with one of the plasma processes;

computing singular vectors for each sample matrix formed in said forming step;

reducing the singular vectors computed for each sample matrix to a principal set of singular vectors for each sample matrix, each sample matrix and its corresponding principal set of singular vectors comprising a model associated with the plasma process with which the sample matrix is associated;

storing each model associated with the plasma processes that the wafers are processed in accordance therewith;

associating an additional wafer processed subsequent to plasma processing of the wafers represented in the sample matrix with one of the plurality of plasma processes;

retrieving the model for the plasma process associated with the additional wafer;

computing principal components, a predicted data vector, and a residual data vector for the additional wafer, using the principal set of singular vectors from the retrieved model;

calculating a scalar metric from the residual data vector for the additional wafer;

categorizing the additional wafer based on the value of the scalar metric.

20. The method of claim 19 wherein said sensor data comprises OES data.

21. The method of claim 19 further comprising the step of:

identifying each plasma process by the processing chamber in use and the process recipe in use.

22. The method of claim 21 wherein, in said step of forming, at least one sample matrix is formed by selecting a single data vector at a time of interest during the processing of each wafer.

23. The method of claim 22 wherein the time of interest comprises an endpoint of the process.

24. The method of claim 22 further comprising the steps of:

updating the sample matrix of at least one model associated with each process by deleting from the sample matrix a data vector corresponding to at least one wafer processed earlier in time and adding to the sample matrix a data vector corresponding to at least one wafer processed later in time; and

periodically recomputing the singular vectors of the sample matrix; and

periodically reducing the singular vectors to a set of principal singular vectors.

25. The method of claim 21 wherein, in said step of forming, at least one sample matrix is formed by averaging a plurality of data vectors obtained during the processing of each wafer to obtain a single average data vector for each wafer.

26. The method of claim 25 wherein, in said step of forming, only data vectors obtained after a predetermined time from a start point of plasma processing of each wafer up to a predetermined time before an endpoint of plasma processing of each wafer are averaged to obtain the single average data vector for each wafer.

27. The method of claim 25 further comprising the steps of:

updating the sample matrix of at least one model associated with each process by deleting from the sample matrix a data vector corresponding to at least one wafer processed earlier in time and adding to the sample matrix a data vector corresponding to at least one wafer processed later in time; and

periodically recomputing the singular vectors of the sample matrix; and periodically reducing the singular vectors to a set of principal singular vectors.

28. The method of claim 19 wherein said step of storing comprises:

saving each model associated with the plasma processes that the wafers are processed in accordance therewith in at least one of a computer memory and a recording medium.

29. The method of claim 19 wherein said step of calculating a scalar metric from the residual data vector for the additional product unit is performed in real time as wafers are plasma processed.

30. A system for use in monitoring industrial processes, said system comprising:

a data selection module operable to obtain at least one data vector corresponding to each of a plurality of product units being processed;

a sample matrix building module operable to build at least one sample matrix from data vectors corresponding to at least two of the product units;

a principal component analysis module operable to compute principal singular vectors for a sample matrix input thereto, the sample matrix and principal singular vectors thereof comprising model data, said principal component analysis module being further operable to compute, from the principal singular vectors associated with the sample matrix input thereto, principal components, a predicted data vector, and a residual data vector for each additional product unit that is processed subsequent to processing of the product units represented in the sample matrix input thereto;

a model maintenance module operable to identify a process identity for a product unit currently being processed from among a plurality of process identities, store model data associated with the identified process identity, and retrieve stored model data associated with the identified process identity; and

a product unit categorization module operable to categorize each additional product unit that is processed subsequent to processing of the product units represented in the sample matrix based a scalar metric calculated from each residual data vector for each additional product unit.

31. The system of claim 30 wherein said data selection module is operable to obtain at least first and second data vectors corresponding to each of a plurality of product units being processed, said first data vector comprising a single original data vector occurring at a time of interest, and said second data vector comprising an average of a plurality of original data vectors occurring over a specified range of times in the process.

32. The system of claim 31 wherein said sample matrix building module is operable to build at least one of a first sample matrix comprising first data vectors, a

second sample matrix comprising second data vectors, a third sample matrix comprising first data vectors and a fourth sample matrix comprising second data vectors, wherein said first and second sample matrices remain intact after being initially built, and wherein said third and fourth sample matrices are updated after being initially built.

33. The system of claim 32 wherein said third sample matrix is updated by deleting a first data vector therefrom corresponding to a product unit processed earlier in time and adding a third data vector thereto corresponding to a product unit processed later in time.

34. The system of claim 32 wherein said principal component analysis module is operable to compute principal singular vectors for said first, second, third and fourth sample matrices, said principal component analysis module being further operable to compute, from the principal singular vectors associated with the first, second, third, and fourth sample matrices, principal components, a predicted data vector, and a residual data vector for each additional product unit that is processed subsequent to processing of the product units represented in the sample matrix input thereto.

35. The system of claim 34 wherein said model maintenance module is operable to:

store first, second, third and fourth models associated with the identified process identity, wherein said first model comprises the first sample matrix and associated principal singular vectors for the identified process identity, said second model comprises the second sample matrix and associated principal singular vectors for the identified process identity, said third model comprises the third sample matrix and associated principal singular vectors for the identified process identity, and said fourth model comprises the fourth sample matrix and associated principal singular vectors for the identified process identity, and

retrieve said first, second, third, and fourth models associated with said process identity identified with each of said plurality of product units being processed.

36. The system of claim 30 further comprising:

a data output module operable to output on an output device at least one of the scalar metric calculated from each residual data vector for each additional product unit and the category assigned to each additional product unit based on the calculated scalar metric.

37. The system of claim 36 wherein said output device comprises at least one of a display screen, a printer, and a plotter.

38. The system of Claim 30 wherein said data selection module, said sample matrix building module, said principal component module, said model maintenance module, and said product unit categorization module comprise a computer program executable by a microprocessor.

39. The system of claim 30 wherein said data selection module is operable to obtain at least one data vector corresponding to each of a plurality of product units being processed in real time as each product unit is processed.

40. The system of claim 30 wherein said principal component analysis module is operable to compute the principal components, the predicted data vector, and the residual data vector for each additional product unit that is processed subsequent to processing of the product units represented in the sample matrix input thereto in real time as each additional product unit is processed.

41. The system of claim 30 wherein the industrial processes comprise plasma processes and wherein the product units comprise semiconductor wafers.

42. The system of claim 41 wherein the data vector comprises OES data.

43. The system of claim 30 wherein the data vector comprises at least one of mass spectrometer data, electrical sensor data, and RF sensor data.